

Clinical Decision Support Software Models and Capabilities

Brian Russell, Auckland University of Technology and Contempo Lab

Barbara Burian, NASA Ames Research Center

Dana Levin, Weill Cornell Medical Center Department of Emergency Medicine and The Exploration Medicine Company

*Aerospace Medical Association
92nd Annual Scientific Meeting
Reno, NV
May 2022*



Disclosure Information

92nd Annual Scientific Meeting

Brian Russell



I have no financial relationships to disclose.

I will not discuss off-label use or investigational use in my presentation



Clinical Decision Support System (CDSS)

A software tool to act as an assistant off-loading tasks, alerting anomalies and making timely suggestions when required.



A CDSS Tool Must be Context Aware



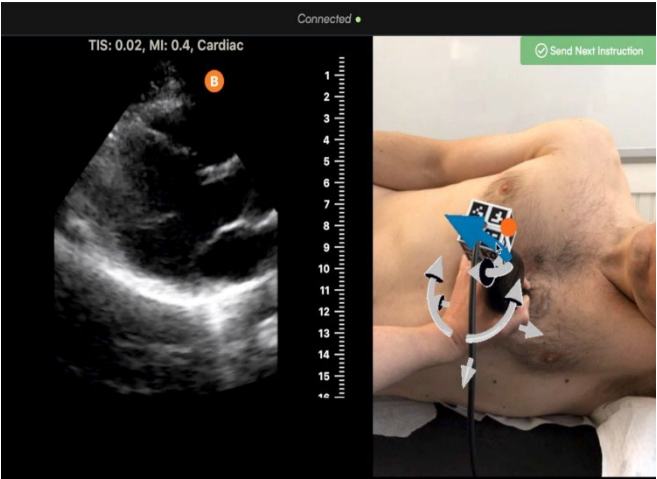
Adapt to

- “Knowledge, Skills and Abilities (KSAs)” and fatigue
- Acuity and severity of scenario
- Resource constraints and mission duration

- Increase “**Scope of Practice**” levels for crew
- Automate data entry and recall across the team
 - e.g., Electronic Health Record (EHR), pharmacy, resources
- Remove **unnecessary information** on screen
- Assist with **decision making** for diagnosis, treatment and observation
- Continually monitor systems and crew to detect anomalies early.



Benefits of a CDSS are found in applications such as emergency assistance, alerts and notifications, prevention, training, guidance for exam procedures, monitoring crew performance and diagnosis of symptoms



Ai advisor for Ultrasound Guidance, Butterfly, 2021



Sleep Analysis, Oura Ring, 2021

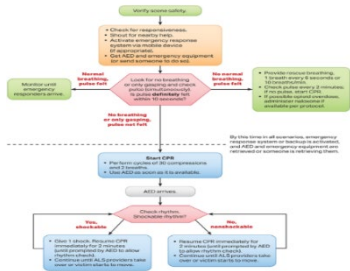


Life Support, Philips Tempus Pro (Philips, 2019)



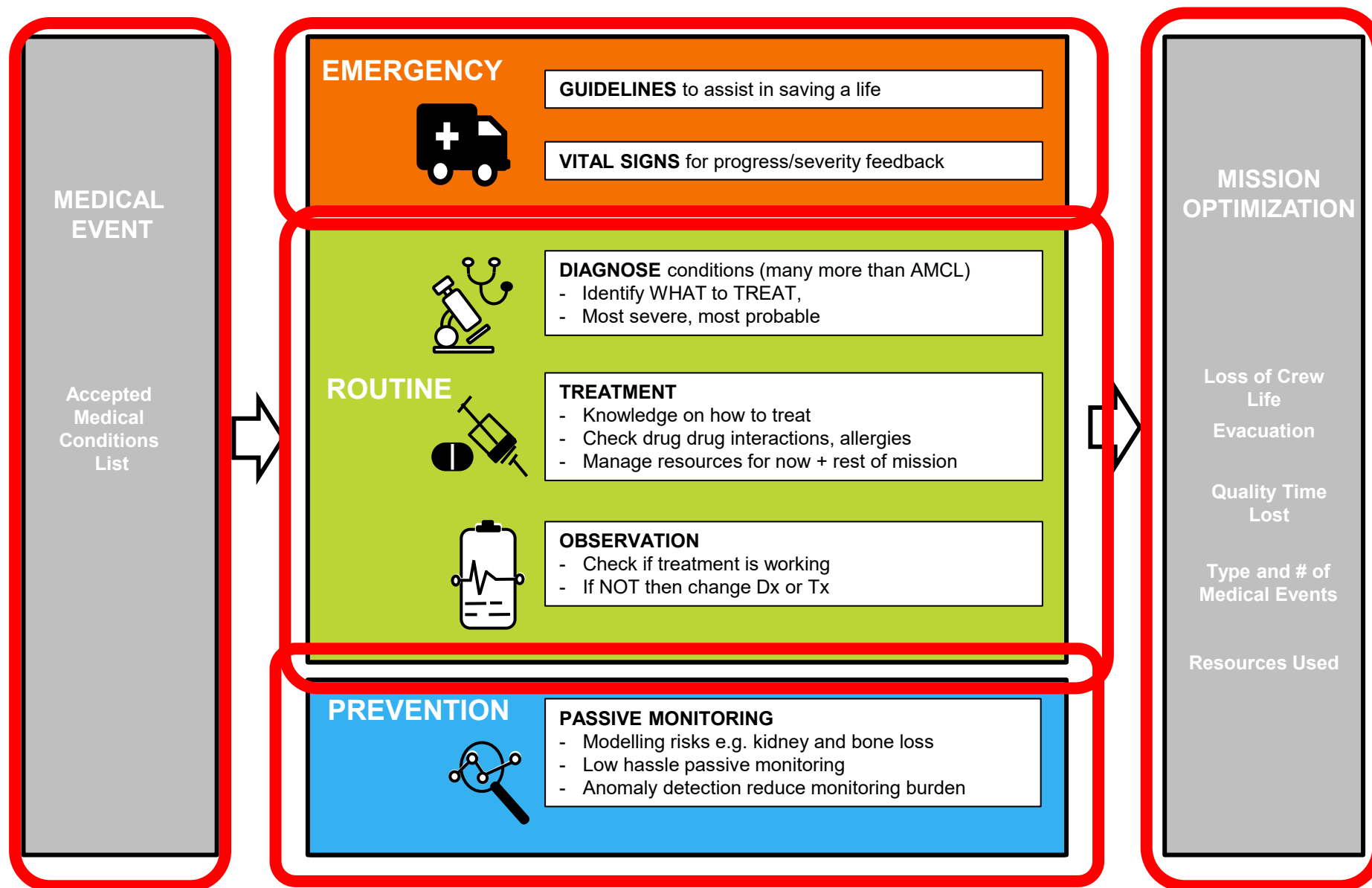
Apple, Inc. Watch® ECG App, 2020

Trade names and trademarks are used in this report for identification only. Their usage does not constitute an official

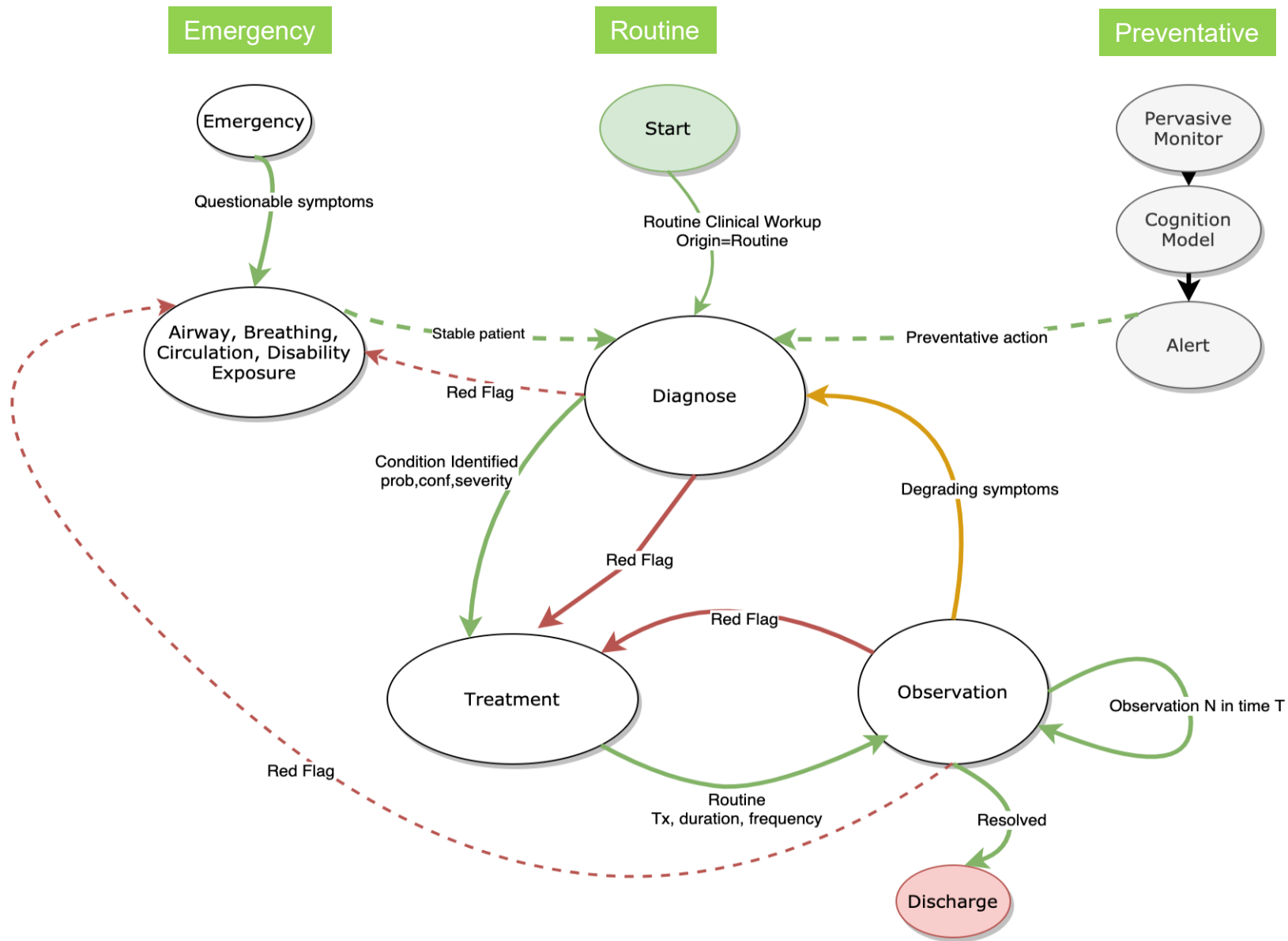


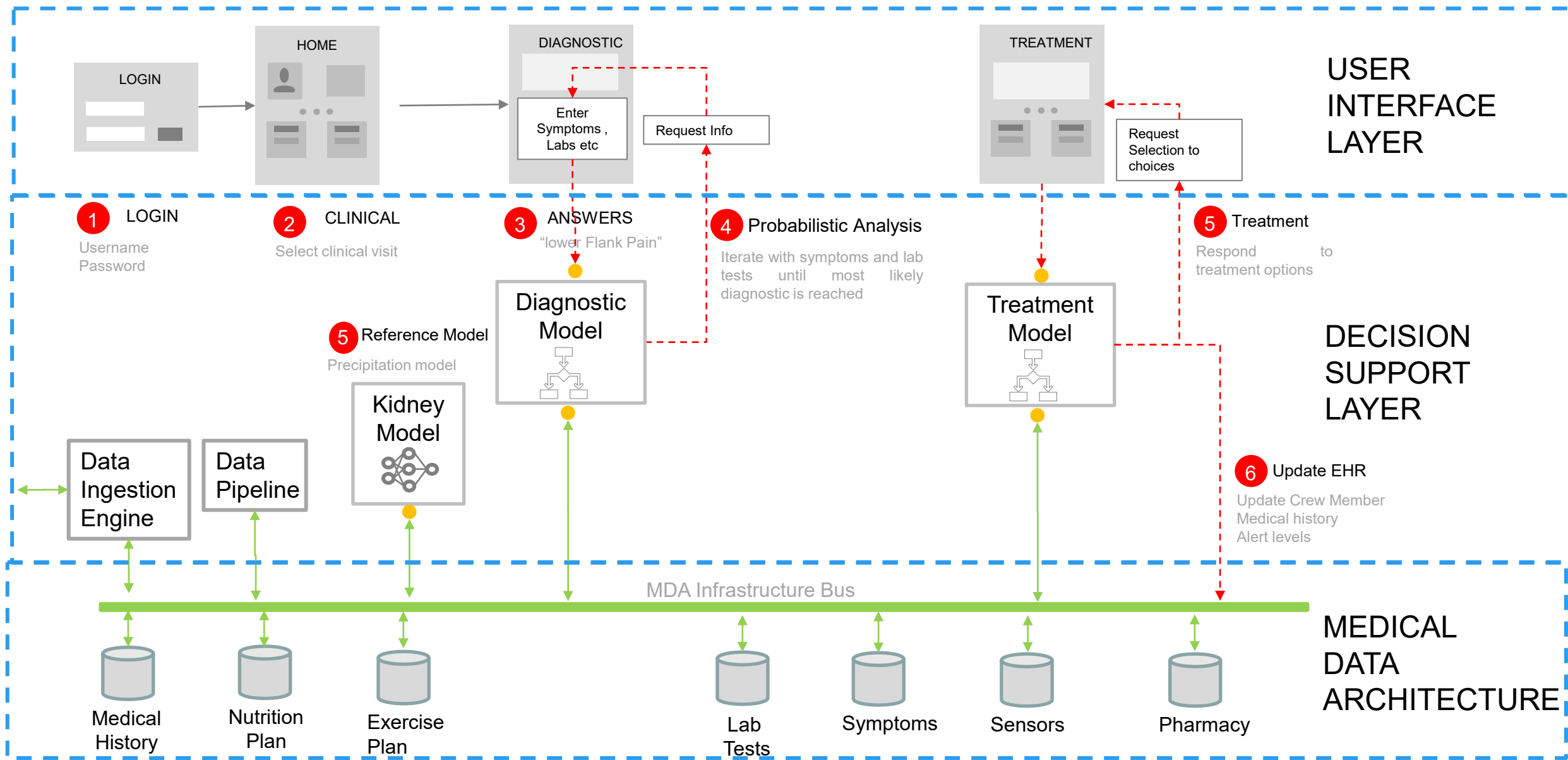
ALS Algorithm, American Heart Association, 2020

CDSS Can be Defined by Acuity Level



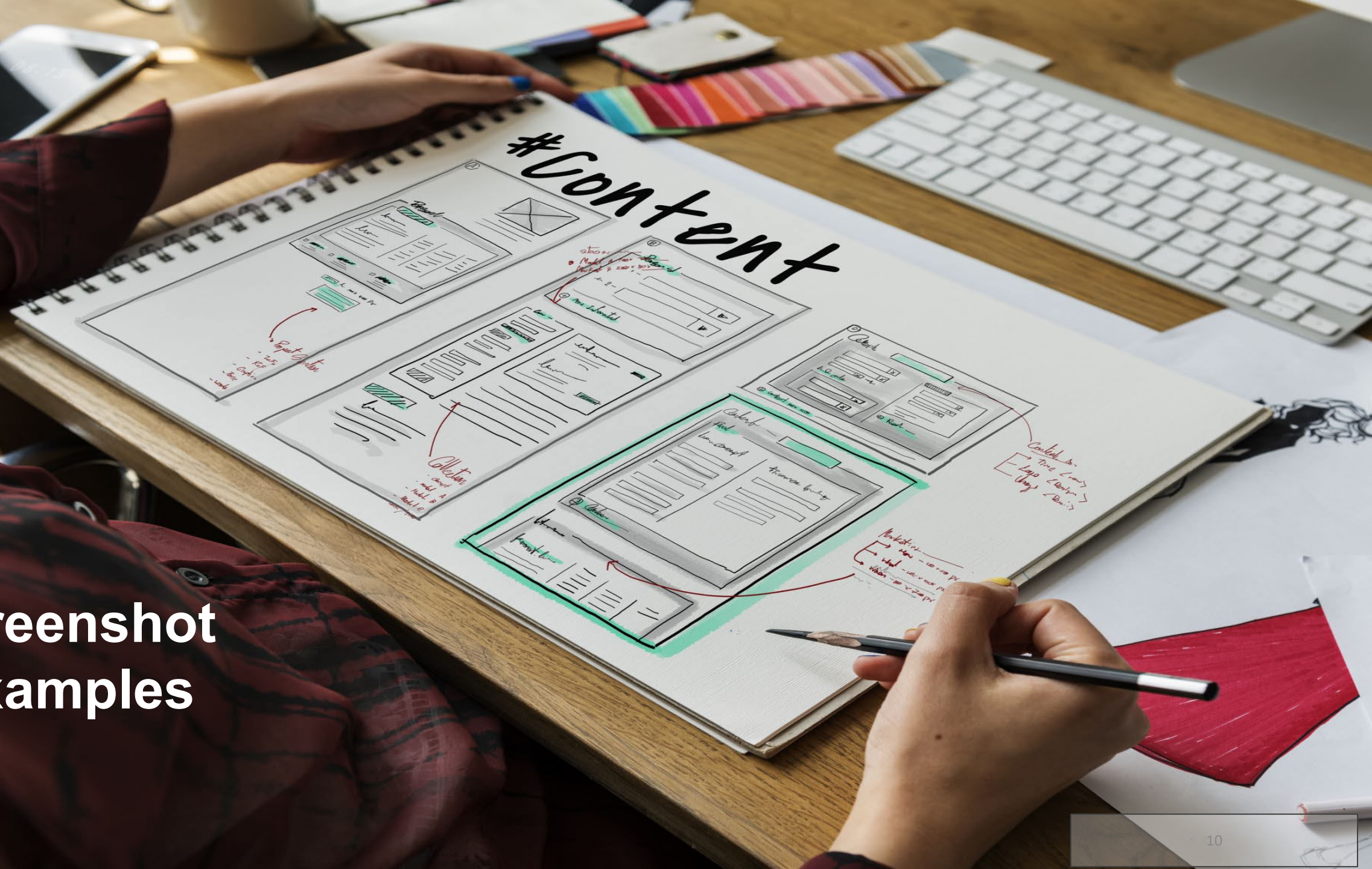
Clinical Workflow Between Scenarios







Screenshot Examples



Emergency Context



30 Jul 2024 Current Time 10:12:33 Event Start Time 09:40:21 Event Elapsed Time 00:32:12

Emergency Assessment & Response

Patient: Jane Smith Trans Female SMS Get Help Diagnosis, Treatment & Disposition Alerts & Messages
Allergies: bee venom Ht: 182.45 cm Wt: 72.06 kg Emergency! Close Session • Temperature is elevated but stable: monitor
Blood Donor: John Doe

Timer: Pulse Check: 1m 20s

Checklist

Log Procedures

Diagnosis: Supraventricular Tachycardia (SVT) - Stable

Signs: Heart rate > 150 bpm, irregular or sudden onset

Task	Actions
CRM	<input checked="" type="checkbox"/> Get help; identify leader; all don gloves
Pulse Check	>>Note: pulse is present <input checked="" type="checkbox"/> Place defib pads from AED for possible synchronized cardioversion
Airway	<input checked="" type="checkbox"/> Get mask, tubing & supplemental oxygen and connect all <input type="checkbox"/> Place mask, ensure good fit <input type="checkbox"/> Turn oxygen ON: 100% high flow
Establish IV Access	<input checked="" type="checkbox"/> Get 22 G IV catheter, piggyback IV set, & 1 bag saline (1000 mL) <input checked="" type="checkbox"/> Identify vein on back of either hand

Vitals - Sensors

History Alarms ON 100 %

Cardiac

Heart Rate	60 bpm	Normal
EKG	Sinus Rhythm	Normal
Blood Pressure	124/77 mmHg	Normal

Breathing & Oxygenation

SpO ₂	98 %	Normal
Respiration Rate	15 bpm	Normal
Total Carbon Dioxide	40 bpm	Normal

Temperature

Temperature	38.3 °C	High
-------------	---------	------

ECG Pleth CO₂ AWP

Guide, Instruct, Monitor...

Protocol
Guide

On demand
Training

Vital Signs

Lucia Perez - Crew Medical Officer

Patient Select
Lucia Perez

ESI 4

Period 00h 00m 37s

CLOSE CURRENT LOG

Followup Action

Is the pain intermittent?
☐ True ☒ False

SEND RESPONSE

PREVIOUS CHANGE QUESTION NEXT

Symptom Log

1 Back Pain

2 Do you have lower flank pain? true

3 Is the pain intermittent? false

HR

SpO2

BR. mmHg

RR.

--

--

--

--

CDS Assistant

Labs

#	DISEASE	P R O B	S E V	C O N
1	Kidney Stones	75	50	80
2	Pyelonephritis	22	50	70
3	ACS	11	90	40
4	Anxiety	15	20	55
5	Atrial Fib	05	80	43
6	Headache CO2	10	30	80
7	Space Motion Sickness	13	10	40

Current Labs

Blood Lab Report
WBC: 5.13

Urine Lab Report
Color: Yellow
Bacteria: Occasional

FULL REPORT

FULL REPORT

Questions

Log

Vital Signs

Lab Reports

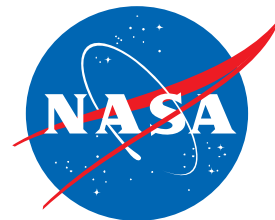
Diagnostic Report

Assisted decision making

- Naturalistic decision making like a human
- Next best question with greatest positive predictive power
- Probability, severity and confidence to aid decision making



- **Autonomy will increase with duration and distance**
- **CDSS will increase autonomy by increasing Scope of Practice**
- **CDSS Modelling is restricted to approaches that run parallel to human decision making to assist throughout the clinical process.**
- **Validation is important.**



THE END



Autonomy

Crews will become increasingly autonomous requiring decisions and actions to be made with less support from the mission control center.

Clinical Decision Support

Part of Crew Health and Performance

